Monitoring Streambanks and Riparian Vegetation—Multiple Indicators

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INTRODUCTION

The purpose of *Monitoring Streambanks and Riparian Vegetation—Multiple Indicators (or Multiple Indictor Method - MIM)* is to provide an efficient and effective approach to monitoring the effects of livestock grazing on streamside habitats. This protocol is designed to meet the recommendations in the *University of Idaho Stubble Height Study Report* to integrate annual grazing use and long-term trend indicators. The monitoring procedures described in this document , can be used to evaluate current livestock grazing management practices, i.e., timing, frequency, and duration of grazing, and to determine whether the vegetation and streambanks are responding to livestock grazing management as anticipated.

Adaptive livestock grazing management, as described by the University of Idaho Stubble Height Study Team (2004) requires developing specific riparian and streambank management objectives, a grazing management plan designed to meet those objectives, and long-term monitoring criteria used to evaluate success. Annual monitoring of livestock use helps determine if the management plan is being implemented and if the prescribed use levels in the plan are achieving resource objectives. This includes monitoring annual trigger and endpoint indicators , assessing the effects of these impacts on resource objectives, and then evaluating whether or not the grazing plan needs to be adjusted. .

Trigger indicators of livestock use (e.g., residual stubble height , woody species use, streambank alteration, use compliance, changes in species preference) are monitored to determine when to move the animals to another grazing area. Endpoint indicators of livestock use (residual stubble height, woody species use, streambank alteration) are monitored after the end of the growing and grazing season to determine if the use or disturbance was with the prescribed levels. Endpoint monitoring data provides information necessary to evaluate the effect of grazing on long-term trend.
Single indicators of condition or trend are usually not adequate to make good decisions (University of Idaho Stubble Height Study Team, 2004). Data on the condition and trend of vegetation andstreambanks, and knowledge of current management practices helps establish "cause-and-effect" relationships important for making appropriate decisions. Such information allows the refinement and development of more realistic, locally derived livestock use criteria.

Appropriate vegetative cover, stream channel geometry (width and depth), and streambank stability is essential for achieving good water quality and aquatic habitat. Monitoring the current year's grazing impacts (short-term monitoring of livestock use) along with long-term indicators of riparian vegetation,streambank, and stream channel conditions at the same location, provides the basis for making grazing adjustments needed to achieve desired conditions. Livestock use indicators (e.g., stubble height, streambank alteration, and woody species use) alone do not provide the data needed to determine condition and trend.

Previous approaches have been relatively inefficient; partly due to the fact that separate protocols were required for each indicator. This protocol combines observations of up to seven indicators along the same transect, using simple refinements of the existing protocols. Since travel time to field sites represents a considerable time commitment, collecting multiple indicators at one location, using one protocol, is more efficient.

This monitoring protocol addresses eight procedures that can be used to monitor streambanks and associated riparian vegetation. Four procedures provide indicators for long-term (trend) monitoring: 1) modified greenline vegetation composition, 2) modified woody species regeneration, 3) streambank stability, and 4) greenline-to-greenline width. These indicators provide data to assess the current condition and trend of the streambanks and vegetation. They help determine if local livestock grazing management strategies and actions are achieving the long-term goals and objectives for stream riparian vegetation and aquatic resources. Monitoring procedures for vegetation include modifications of greenline vegetation composition and woody species regeneration described by Winward (2000) and Coles-Ritchie *et al* (2003). Streambank stability is a modification of the method described by Henderson *et al* (2003). The authors devised greenline-to-greenline width measurement.

Three additional indicators provide data to livestock grazing use. The protocol includes: **5.** livestock use on woody plants [formerly the Key Forage Plant Method] (Interagency Technical References, 1996), **6.** modified residual vegetation (stubble height) described in the Interagency Technical Reference (1996) and Challis Resource Area (1999), and **7.** streambank alteration described by Cowley (2004). These monitoring procedures provide data needed to refine and make annual changes to livestock grazing management practices necessary to meet long-term management objectives and facilitate adaptive management.

Procedures were modified to allow the use of a prescribed plot size to allow collecting data for all seven indicators in a single pass. Distinct and specific rules were developed to facilitate the use of the plot and to maintain consistency, precision, and accuracy of the data.

The eighth procedure consists of permanent photo points. Photo points provide a long-term visual record of streambank and riparian conditions and trend. The protocol described in this document recommends a minimum number of photographs needed for an acceptable visual record. More detailed photo monitoring may be added if required to document or answer management questions.

Photographs should also be taken to document annual grazing use at the monitoring site. This helps those interpreting the data at a later time to visualize the results of the data being analyzed.

Methods described in this protocol were selected because of their direct relationships to livestock management on streambanks and riparian vegetation. The amount of residual vegetation (stubble height) left at the end of the season has a direct relationship to the long-term productivity of herbaceous riparian plants and ultimately on the composition of vegetation along the greenline (measured using the greenline vegetation composition procedure). Streambank alteration evaluates the amount of disturbance caused by livestock that may have a direct relationship to streambank stability and the recovery of vegetation along the greenline. Shrub use along the greenline, as measured by woody species use, directly affects the health of woody plants on the streambanks. For example, research has shown that heavy to extreme use by grazing animals every year is detrimental to plant health, while light to moderate use maintains overall plant health. (Thorne, et al 2005). In addition, continued heavy to extreme use of woody species can limit the plant's ability to regenerate. Greenline-to-greenline width is the non-vegetated width of the stream channel between the greenlines on each side of the stream. It provides an indicator of stream channel narrowing which is common with streambank vegetation recovery, or stream channel widening in consequence of reduced streambank erosion resistance of the riparian vegetation.

We suggest that Riparian Proper Functioning Condition (PFC) Assessment may complement riparian assessments using the MIM procedure. PFC assesses a much broader reach of stream. However, it is a qualitative method for assessing the condition of riparian-wetland areas, and because precision and repeatability are problematic, it should not be used for monitoring. It uses hydrology, vegetation, and erosion/deposition (soils) attributes and processes to qualitatively assess the condition of riparian-wetland areas. Some of these same attributes, particularly vegetation and streambank stability/erosion, are quantitatively measured using the MIM procedure. Procedures for PFC assessment are found in the BLM Technical Reference 1737-15, *Riparian Area Management; A User Guide to Proper Functioning Condition and the Supporting Science for Lotic Areas*.

SELECTING DESIGNATED MONITORING AREAS (DMA)

A designated monitoring area (DMA) is the location in riparian areas and along the streambanks within a livestock grazing unit where monitoring takes place. DMAs are areas representative of grazing use specific to the riparian area being assessed and should reflect what is happening as a result of on-the-ground management actions. DMAs should not reflect an average amount of use in all riparian areas of the stream reaches in the pasture. Instead, they should reflect typical livestock use where they enter and use vegetation in riparian areas immediately adjacent to the stream. DMAs may be selected where livestock use exceeds the apparent average use of riparian areas in the pasture. For example, the assumption is made that since the DMA reflects higher use than other stream segments within the pasture and is meeting resource objectives, then the rest of the stream in that pasture is also meeting objectives.

The following criteria are used to select DMAs (see Appendix A):

- DMAs represent riparian areas <u>used</u> by livestock. Select the site based on the premise that if proper management occurs on the DMA, the remainder of the riparian areas within a pasture or use area will also be managed within requirements.

- Select sites that are representative of use, not an average for the stream within the pasture or allotment. For example, if a livestock use one-half mile of a stream reach in the pasture and one mile is not used because it is protected by vegetation, rock, debris, or topography, the DMA location should represent the stream reach that livestock actually use.

- Monitoring sites should have the potential to respond to and demonstrate measurable trends in condition resulting from changes in grazing management. Livestock trails associated with livestock use of the riparian area may be included in the DMA.

- Avoid selecting sites where vegetation is not a controlling factor, such as cobble, boulder, and bedrock-armored channels.

- Do not place DMAs in streams over four percent gradient unless they have distinctly developed flood plains and vegetation heavily influences channel stability.

- Avoid putting DMAs at water gaps, or locations intended for livestock concentration, or areas where riparian vegetation and streambank impacts are the result of site specific conditions (such as along fences where livestock grazing use is not *representative* of the riparian area). These local areas of concentration may be monitored to address highly localized issues, but they should not be considered as representative of livestock grazing management over the entire riparian area within the grazing unit, and are therefore not generally chosen as DMAs.

SELECTING APPROPRIATE INDICATORS

After the DMA has been located, it is important to select the appropriate objectives and indicators for the site and management strategy. Site potential or capability (vegetation and stream type), management objectives for vegetation, streambanks, and stream channel, timing, duration, and frequency of the grazing strategy, and monitoring questions must all be considered when selecting the indicators that are to be monitored (see Appendix B).

- General goals and/or broad objectives are usually established in the agency land use plans, i.e., forest resource plans, resource management plans (RMP), management framework plans (MFP), allotment management plans, ranch plans, and other management plans.

- An understanding of the basic geomorphic processes and vegetation responses are important to interpreting the potential of the stream, and therefore the desired future condition. Streams with substrate and banks dominated by gravel, with limited fine sediment loads, are likely to be dominated by woody vegetation. In such instances, Herbaceous vegetation is likely to be slow to develop, as these types require more fine soils to become established.

- Riparian Management Objectives should reflect the attainable condition. For example, incised stream channels may not likely fill with sediment under current climatic regimes. Miller *et al* (2004) states “The dominant process operating within the upland stream systems today is channel incision.” Therefore, it is likely that incised channels will widen, develop a new floodplain, and stabilize the channel near the current elevation. In some rare instances, however, incised channels will fill with sediment and move toward a stable state at the elevation of the channel prior to incision.

- Appendix A, page A-5: Key to Greenline Capability Groups (Winward 2000) describes general vegetation capabilities. When better information is not available, this may be used to help develop objectives for the amount and kind of vegetation necessary to achieve proper functioning condition.

Appropriate indicators may change over time. For example, the DMA is dominated by graminoid species with no willows or woody species present. Since there are no woody species found along the transect, woody species regeneration and woody species use were not selected as indicators. However, there is a potential for willows and other woody species on most streams with a gradient of 0.05 percent or more and periodic over bank flooding with deposition

(Winward 2000). Woody species reproduction is episodic, as they require a seed source, freshly deposited soil, and moisture for a sufficient time to develop a root system adequate to support the seedling until it is established. When these conditions occur, it is appropriate to add woody species regeneration and woody species use to track the changes.

- Pastures that are in a rest period may only need validation that livestock use has not occurred . Stubble height, streambank alteration, and woody use monitoring may not be done during that year if it is not answering a specific question.

- Another situation that may be common is finding that one of the annual indicator thresholds is reached consistently before other, e.g., streambank alteration reaches threshold levels before woody species use or stubble height criteria are met. The decision may be to discontinue the stubble height and woody species use and use only streambank alteration each year. However, caution must be exercised since the annual indicators can be affected differently based on the season of use. For example, maximum willow use may be the first indicator met in a riparian zone used late in the fall (well before streambank alteration or stubble height). When the same pasture is used in the spring it is unlikely that willow use will occur first – stubble height or streambank alteration would likely be the most appropriate to monitor.

ESTABLISHING THE LINE TRANSECT

After the DMA is selected, a permanently marked line transect is established, consisting of the greenlines and streambanks on both sides of the stream. This allows evaluation of the data collected to help determine the relationship of the livestock grazing strategy to the condition and trend of the streambanks and riparian vegetation.

- The line transect at the DMA extends at least 110 meters (361 feet) along the stream. Longer reaches may be needed on larger streams (over 5.5 meter (18 feet) bankfull width), or those with extreme variability or site complexity.

- Permanently mark the lower and upper end of the reach. Place the lower marker, rebar or other suitable material, on the left-hand side (looking-up stream). Steel t-posts are not recommended for this since they attract livestock and will lead to concentrated impacts on the reach. Streamside markers should be made of securely capped or bent over larger-diameter rebar or similar material. Straight, jagged, rebar stakes that are not capped or bent-over present a serious hazard to horses and other livestock. Pace 110 meters (361 feet) up the stream along the thalweg or greenline and place the upstream marker on the right-hand side (looking up stream). Markers should be placed a sufficient distance from eroding banks to reduce the risk of losing the marker (see Appendix C, Figure 1).

- It is recommended that a reference marker (e.g., steel post, marked post in a fence line, tree with a marker, unique rock, or other natural feature) *at least* 30 meters (100 feet) away from the plot location be placed or described to assist locating the transect in the future. Record the distance and compass bearing from the reference marker to the lower plot location marker. Provide a geographic positioning system (GPS) location (UTM or Latitude-Longitude) for the reference marker, lower, and upper transect markers. Sketch the monitoring set-up to make sure future visits use the same starting side of the stream.

SKILLS, TRAINING, COLLECTION, TIME, AND EQUIPMENT

Skills

Individuals must have a basic understanding of riparian ecology and stream function. This requires knowledge of riparian species identification, erosion, and deposition processes.

Training

Training is required to successfully apply this monitoring protocol. At minimum, observers should receive the basic 2-day training module, including the overview, data analysis, field presentation, and field-testing. Ideally, field practitioners would also apply the protocol for several field days in the presence of trainers to gain proficiency in the methodology. The Effectiveness Monitoring Team has applied such field training, for example, bank alteration measurement variability among observers was reduced from about 30 percent variation without training to about 12 percent with training.

Training should emphasize methods to correctly locate and identify stems associated with woody plants. There should be adequate time to describe and classify the full range of bank stability conditions encountered in the field.

Collection Time

If all six indicators are monitored in the same year, sample time is approximately 2 to 4 hours per site. Normally a subset of the indicators is chosen in a given year, and sampling is typically about 2 hours per site. Depending upon travel time, from 2 to 4 sites are sampled per day.

Equipment

See Appendix O

MONITORING PROCEDURES
(Described in the order indicators are listed on the data form)

1. After the line transect markers are placed, take the needed photographs. This will reduce the chance of streambank disturbance resulting from the monitoring process. As a minimum, take photographs at the following locations:

    a. From the lower marker looking up-stream;
    b. Across the stream from the lower marker;
    c. Down stream from the up-stream marker; and
    d. Across the stream from the up-stream marker.
    e. Take additional photographs as needed and describe the location of each photo in relation to the down-stream marker.

2. Monitoring usually begins at the lower end of the transect left-hand side (looking upstream). Sketch the monitoring set-up, including markers and locations, to make sure future monitoring starts on the same side of the stream.

3. Use only the appropriate indicators for the site (see Appendices B). If the site does not have the potential for woody species with appropriate management, then do not include the woody species regeneration and woody species use as part of the monitoring for the site. However, if the site objectives include woody species, but no woody species are present, woody species regeneration should be included to determine if management is making progress toward meeting the objectives. Woody species utilization data cannot be gathered until woody species begin reestablishing along the greenline .

4. Beginning at the lower transect marker on the left hand side (looking upstream) determine a random number between 1 and 10, take that number of steps along the thalweg (deepest part of the stream) or along the streambank to the first plot location. Place the monitoring frame (see Appendix D) down at the toe of the boot with the center bar along the greenline. Continue the procedure at predetermined intervals (usually 2, 3, or 4 steps, or short enough to obtain 40 plots on each side of the stream) until the upper transect marker is reached. If the required number of plots are obtained prior to reaching the upper marker, **continue reading plots until the marker is reached**. Once the upper marker is reached, cross the stream and repeat the procedure down the other side to the end marker. The entire length of the transect on both sides of the stream is monitored. Individuals should determine the length of their steps and adjust the interval between plots so that an adequate sample size can be obtained. Mark a distance, usually 100 feet, and count the number of steps it takes for that distance. Determine the average step length by pacing the distance three or four times and calculating the average. For example, if an individual takes an average of 66 steps in 100 feet, then the average step length is 18 inches. Table 1 indicates the number of steps needed to obtain at least 40 plots on a side of the stream.

Table 1 – Determining the Number of steps between plots

Step length	To obtain at least 40 Plots per 110 meter (361 feet)Transect	
	Steps between plots	Spacing between plots (in)
15inch	7	105
18inch	6	108
21inch	5	105
24 inch	4.5	108
27 inch	4	108
30 inch	3.5	105

5. Do not use these monitoring procedures immediately following a flood or high flow event resulting in sediment deposition and scour. Sediment deposition and scour makes it

difficult, if not impossible, to determine the effects of the current season livestock use, and some vegetation may be temporarily buried

6. Long-term (trend) monitoring data should be gathered at three to five-year intervals. This allows vegetation and streambanks to respond to the grazing management prescription. In some cases, the period may be extended be cause of slower recovery rates. Ten years should be the longest interval used on any site.

7. Short-term annual indicator data may be collected at a different season than the trend data; however the short-term data should be collected when it is appropriate, typically right after livestock use. If the management prescription requires a certain amount of residual vegetation remaining to protect streambanks during high winter or spring flows, the monitoring should be done after the vegetation has stopped growing in the fall and after livestock have been removed from the area.

8. Use handheld computers to record data (see Appendix E). This saves about one hour per transect . However, the data may be recorded on the Riparian Monitoring Data Sheet if a handheld computer is not available (see Appendices F).

Locating the Greenline

(Modified from Winword 2000)

The Greenline is "The first perennial vegetation that forms a lineal grouping of community types on or near the water's edge. Most often occurs at or slightly below the bankfull stage" (Winward 2000). It is found only along streams with defined channels.

Criteria and Limits

1) "Most often the greenline is located at or near the bankfull stage. . . .At times when the banks are freshly eroding or, especially when a stream has become entrenched, the greenline may be located several feet above bankfull stage." In these cases, the greenline may be non-hydric species, i.e., upland species (Winward, 2000).

2) The location of the greenline should be determined when the stream is at the summer low flow. Usually, the edge of the perennial vegetation, not the waters edge at low summer flow, is the greenline (Winward, 2000). Some perennial vegetation (e.g., spike rush, *Eleocharis* spp.) may grow in the margins of streams and in slow backwaters. When this occurs, the greenline used in this protocol is at the water's edge during summer low flow.

Vegetation

The lineal grouping of perennial vegetation must have at least 25 percent foliar cover and be at least 6 inches (about 15 cm) wide and one quadrat (50 cm or 19.6 inches) in length. Vegetation along streambanks does not need to be continuous to be the greenline. Individual lineal groupings are considered part of the greenline when they meet the criteria described above. Review Appendices C and G for explanations and examples of many greenline locations.

1) Colonizer species at or near the water's edge which meet the appropriate criteria (i.e., 25 percent foliar cover, at least six inches wide and 19.6 inches long, and establish a distinct line of perennial vegetation) are considered greenline, except as described in number 2. For example, short-awned foxtail *(Alopecurus aequalis),* spike-rush (*Eleocharis palustrus*), arroyo willow (*Salix lasiolepis*) and coyote willow (*Salix exigua*) on the streambank (above the summer low flow) should be recorded as part of the greenline (see Appendix G, Figures 2 and 16). These species have moderately deep roots and the ability to stabilize streambanks.

2) Colonizers that commonly float on or submerge in the water, such as brookgrass (*Catabrosia aquatica*), watercress (*Rorippa nasturtium-aquaticum*), seep spring monkey flower (*Mimulas guttatus*), American speedwell (*Veronica americana*), and smartweed (*Polygonum amphibium*), may form grouping in the water or near the water's edge, but are not considered part of the greenline (see Appendix G, Figures 5, 6, 7, and 8).

3) Non-vascular plants such as mosses and lichens are **not** considered as part of the greenline. The quadrat is moved away from the stream, perpendicular to the water flow, until the minimum vegetation, rock, and/or wood meet the criteria for greenlines.

4) Under some conditions, particularly in back waters where the current is slow, *Carex* spp., *Juncus* spp., *Eleocaris* spp., and *Scirpus* spp. may establish in the still shallow water along the stream during the summer low flow periods. This condition occurs most frequently during low water in a drought period. When this occurs, the greenline is along the edge of the water at low summer flow (see Appendix E, Figures 2, 3, 4, 8, and 9).

5) The greenline runs approximately parallel to the stream channel. When the streambank or the vegetation line becomes approximately perpendicular (75 degrees or more) to the flow of the stream, the greenline ends. Then the transect moves away from the stream perpendicular to the stream flow and begins at the next lineal grouping of perennial vegetation continuing along the greenline (see Appendix C, Figures 3 and 4).

6) The greenline is at the rooted base of perennial plants whether it is herbaceous or woody (see Appendix C, Figures 7 and 8).

7) Woody vegetation overhanging the stream is not considered a greenline. The greenline is located at the edge of the nearest lineal grouping of vegetation, including anchored rock and wood, under the canopy or at the base of the perennial woody vegetation (see Appendix C, Figure 8).

8) When shrubs or trees have no understory, the greenline is along a line connecting the streamside edges of the rooted base of the plants when under the drip line (see Appendix C, Figure 6).

9) If there is an overstory tree with a shrub understory, the greenline is at the edge of the drip line of the shrub or the streamside edge of the lowest vegetation layer. For example, if there were a narrow-leaf cottonwood tree over red osier dogwood, the greenline would be at the edge of the dogwood. When as shrub such as willows are over herbaceous vegetation such as sedges, the greenline is at the edge of the sedges or the lower layer of vegetation.

10) Only canopy cover from plants rooted on the streambank on the same side of the stream is recorded. Overhanging canopy from plants on the opposite side of the stream is not recorded as canopy cover, even if it overhangs the plot. This condition often occurs on small streams.

Rock as part of the greenline

Rocks, boulders, talus slopes, and bedrock that are part of the streambank must be of sufficient size to protect that portion of the streambank from erosion during high stream flows and be exposed along the greenline. At least 25 percent of a rockor boulder must be embedded in the streambank, with no evidence of active erosion at the edges of the rock. Appendix G, Figures 33, 37, 38, 41, and 42 provide examples of rock along the greenline.

Rock is recorded as part of the greenline when it is at least 25 percent of the length of the quadrat. If rock is at least 50 percent of the quadrat length, record “rock” as dominant . If rock is 25-49% of the plot, it is recorded as sub-dominant.

Anchored and Downed Wood as part of the greenline

Anchored wood consists of logs or root wads having sufficient size in or along the streambank in such a way that high flows are not likely to move them. The anchoring may be embedded in the streambank or wedged between rocks, trees, or other debris. Anchored wood must currently exert a hydrologic influence on the stream. There should be no evidence of active erosion that would destabilize the woody material . When logs are anchored and somewhat perpendicular to the stream, count the amount of anchored wood that joins the vegetation greenline on each side of the log (See Appendix G, Figures 33 through 36).

When wood is encountered parallel to and anchored in the streambank, record “wood” as the dominant vegetation. Wood may be a dominant, or sub-dominant depending on the amount of linear length within the quadrat. Wood is recorded as part of the greenline when it is at least 25 percent of the length of the quadrat. If wood is at least 50 percent of the quadrat length, record “wood” as dominant or co-dominant. If wood is 25-49% of the plot, it is recorded as sub-dominant.

Detached Blocks of Vegetation

Blocks of vegetation obviously detached from the streambanks are not recorded as greenline. When deep-rooted hydric vegetation covers the block from the water’s edge to the terrace wall creating a new floodplain (false bank), the greenline is the edge of the vegetation along the stream (see Appendix G, Figures 24 through 32).

Islands

Islands, including those surrounded by water at bankfull flow, are not counted as a greenline. The greenline follows the main banks of the stream and not islands (see Appendix C, Figure 3 and Appendix G, Figures 17 through 19).

No Greenline Present

In some instances a greenline may not be present within proximity to the stream. This may be annual vegetation, such as cheatgrass, occupying the upland. In other cases, the area in proximity to the stream may be barren.

A terrace is a relatively flat area adjacent to a stream or lake with an abrupt steeper face adjoining the edge of the stream. The first terrace is the first relatively flat area adjacent to and above the edge of the water. It may be an active floodplain or an area too high for the water to reach under the current climate and channel conditions. The second terrace is the next elevated area above the first terrace, with a distinctly steeper slope facing the stream (see Appendix G, Figures 21 and 22).

Record “NG” or no greenline present when any of these conditions exist:

1. Lineal grouping of perennial vegetation is not present on the first terrace or the second terrace and the first lineal grouping is further than 6 meters (20 feet) of the edge of the stream (see Appendix G, Figure 46).

2. If no obvious terraces are present and lineal grouping vegetation is more than 6 meters (20 feet) from the edge of the water.

3. If sharp meander bends with a narrow peninsula exist with no lineal grouping of vegetation on the side or the top place the frame on the top of the feature (see Appendix G, Figures 47 and 48).

<u>Specific Instructions</u>

1. Observers should look ahead and determine the greenline. This provides continuity for pacing in the appropriate location. The center of the monitoring frame is placed along the greenline.

2. Evaluate the vegetation within the monitoring quadrat on the floodplain side of the greenline (see Appendix C, Figure2).

3. When there is less than 25 percent perennial foliar vegetation cover, including shrub and tree overstory, move up the bank, perpendicular to the stream flow, until the quadrat has the appropriate amount of vegetation. The frame is adjusted along the actual edge of the greenline.

Greenline Vegetation Composition

Vegetation Classification

Two classification systems are commonly used to describe and record the vegetation occurring on the greenline, i.e., riparian community types and dominant plant species. Document the vegetation classification method used on the field sheet or handheld computer.

<u>Recording vegetation using dominant plant species</u>

Dominant plants are the species having the largest portion of the vegetation composition in the quadrat. To be considered dominant, the plant must represent at least 25 percent of the plant composition within the quadrat. The exception is where a *mature* tree or *mature* shrub overstory occurs. Mature trees or shrubs with any portion of the canopy covering the quadrat are considered dominant. This exception applies only to mature trees and shrubs; seedlings and young plants rooted within the plot must have 25% of the vegetative composition to be considered dominant. Plants are classified as dominant when only a single species is found within or over the quadrat. When two or more species make up a majority of the composition in or over the quadrat and are of approximately equal proportions, each is recorded as dominant. **Sub-dominant** plants occur when the composition of a particular plant species or group of plants, e.g., mesic forbs, are less than the dominant specie(s). Sub-dominant plants do not have to exhibit 25 percent vegetative composition within the quadrat (although it is possible). An example of this would be if the quadrat contained 75 percent water sedge *(Carex aquatilis)* and 10-25 percent Kentucky bluegrass *(Poa pratensis)*. In this case, the sedge would be recorded as dominant and the bluegrass as sub-dominant. See Appendix H for a list of common dominant species in the intermountain area.

1. **How to address overstory vegetation:** Riparian vegetation structure may occur in three layers: trees, shrubs, and herbaceous. Mature plants, with any part overhanging the plot (e.g. willows) are always recorded as dominant vegetation. Seedlings and young plants must be rooted within the plot to be counted, and are treated the same as understory vegetation. When quaking aspen (*Populus tremuloides*) occurs with an understory of red-osier dogwood (*Cornus sericea*), both the taller plant layers of quaking aspen and the red-osier dogwood are recorded as dominant plants. A third dominant plant may be listed if an herbaceous understory is present and makes up at least 25 percent of the understory composition of plants in the plot (anchored rock and wood are also part of the cover). Another example: yellow willow *(Salix lutea)* occurs in the overstory with a dense mat of Nebraska sedge *(Carex nebraskensis)* in the understory within the plot. In this case, yellow willow would be recorded as dominant and the Nebraska sedge would also be recorded as dominant.

2. **When to include Sub-dominant plant**s: Users should record important plants that have less than 25 percent of the vegetative composition. These species may include plants that indicate potential, trend, or invaders. For example, Kentucky bluegrass (*Poa pratensis*) dominates a plot with a minor component of Nebraska sedge (*Carex nebraskensis*). The Kentucky bluegrass would be listed as the dominant plant and even though the Nebraska sedge is only a minor portion of the vegetation composition, it is recorded as sub-dominant to track composition trends through time.

3. **How to deal with plants having equal composition:** When two or more plant species, including rock and wood, have about the same amount of plant cover in the plot, and each is over 25 percent of the composition, record each as dominant. Dominant plants are recorded on separate lines under the same plot number. These transition vegetation communities are important in describing the ecological processes occurring along the stream. When this occurs, list the most dominant species first and the second species on the next line.

4. **How to deal with Rock and Wood:** Rock and/or wood making up at least 25 percent of the length of the greenline within the quadrat is considered either dominant, or sub-dominant depending on the vegetation in the remainder of the quadrat. For example, anchored rock is 25 percent of the length the quadrat and beaked sedge is 75 percent. Beaked sedge would be the dominant and rock the sub-dominant. If rock made up 50 percent of the length and beaked sedge the remainder, rock and beaked sedge are both dominant.

5. **Recording the data:** Record data either on a handheld computer or on the Riparian Monitoring Data Sheet (see Appendix F) by dominant vegetation species or community type that has the majority within monitoring frame on the field form or in a computer.

Recording vegetation using riparian community types

Riparian Community Types may be used when riparian vegetation in the area has been classified. When riparian community types are used, record the riparian community type publication that is being used to classify the vegetation. *Riparian Community Type Classification of Utah and Southeastern Idaho* is a typical publication. When using riparian community type classification, it is very important to use the keys provided in the publication for consistency.

Rock and/or wood making up at least 25 percent of the length of the greenline within the quadrat is classified as a distinct community type. For example, anchored rock is 25 percent of the length the quadrat and beaked sedge CT is 75 percent. Beaked sedge would be listed as the dominant and rock the sub-dominant on the data sheet. If rock made up 50 percent of the length and beaked sedge the remainder, rock and beaked sedge are both dominant.

Record riparian community types exactly the same as those listed in the tables in Appendix I or in the tables in the handheld computer. For example, Booths willow (*Salix boothii*)-Kentucky bluegrass (*Poa pratensis*) is recorded “SABO/POPR” in the appropriate column.

Streambank Alteration

General Description

The procedure describes a method for measuring the percent of the linear length of streambank that has been altered by large herbivores (e.g., cattle, horses, sheep, bison, elk, and moose) walking along or crossing the stream during the current grazing season.

The part of the streambank that is measured using this protocol is an area 20 cm on each side of the greenline. This focuses on that portion of the streambank most subject to the erosive effects of water (see Appendix J).

Streambank Alteration Definitions

Streambank alteration occurs when large herbivores, e.g., elk, moose, deer, cattle, sheep, goats, and horses walk along streambanks or across streams. The animals' weight can cause shearing that results in direct breakdown of the streambank and widening of the stream channel. It also exposes bare soil, increasing the risk of erosion of the streambank. Animals walking along the streambank may increase the amount of soil exposed to the erosive affects of water by breaking or cutting through the vegetation and exposing roots and/or soil. Excessive trampling causes soil compaction resulting in decreased vegetative cover, less vigorous root systems, and more exposure of the soil surface to erosion.

Hoof shearing is the most obvious form of streambank alteration. It is recognized by the obvious hoof marks on the streambank. It is common for the shearing action of the hoof to break off a large portion of the streambank. Include as alteration the total length of broken streambank directly associated with an occurrence of shearing, not just the width of the hoof mark (see Appendix J).

Trampling is considered streambank alteration when:

- Streambanks are covered with vegetation and have hoof prints that expose at least 12 mm (about ½ inch) of bare soil;

- Streambanks with broken vegetation cover resulting from large herbivores walking along the streambank and have a hoof print at least 12 mm (½ inch) deep. Measure the total depression from the top of the displaced soil to the bottom of the hoof impression; and/or

- Streambanks have compacted soil caused by large herbivores repeatedly walking over the same area even though the animal's hoofs sink into and/or displace the soil less than 12 mm (½ inch) .

Large herbivores trampling and trailing on top of terraces, above the active floodplain, is not considered streambank alteration. Hoof marks within the plot with shearing on the streambank and/or terrace wall and/or trampling at the base of the streambank or terrace wall are considered streambank alteration (see Appendix J, Figure 5).

Procedure

The procedure uses the entire 42 cm by 50 cm monitoring frame. Five lines are projected across the frame perpendicular to the center pipe (see Appendix D, Figure 1).

1. Looking down at the entire frame, determine the number of lines within the plot that intersect streambank alteration (see Appendix J). Record the number of lines (0 – 5) that intersect streambank alteration. Record only one occurrence of alteration, trampling, or

shearing per line. This process is repeated at the predetermined interval so that 80 to 100 samples are taken (depending upon the length of the step) on each side of the stream. **It is important that the observer determine only the current year's streambank damage.**

2. When there is a vertical or near-vertical terrace wall, pace in the stream or along the greenline on top of the terrace, place the center of the frame along the greenline at the end of the toe. Record only direct alteration occurring on the terrace wall or the streambank (see Appendix J, Figure 5).

3. Hoofprints or trampling on streambanks with fully developed, deep-rooted hydric vegetation (*e.g.*, *Carex* spp., *Juncus* spp., and *Salix* spp.) is not recorded as alteration unless plant roots or bare soil are exposed. Hoof shearing along the streambank is alteration.

4. Compacted livestock trails on or crossing the greenline that are the obvious result of current season use are counted as trampling (see Appendix J, Figures 3 and 4).

5. Roads and tributary streams are **not counted**. Continue to pace directly across the area until the greenline is reached. Record separately on the form any samples that are on the road or water. Leave the cell blank in the handheld computer or on the form.

6. When obstructions such as trees, shrubs, or other physical impediments are encountered, sidestep at 90-degrees from the transect line and continue pacing parallel to the transect to avoid the obstruction. Project the lines from the end frame to the streambank and record the hits. Return to the original transect as soon as possible by sidestepping back to the transect line and continuing.

7. When the greenline is away from the stream channel or the edge of the first terrace, pacing should continue along the edge of the first terrace (see Appendix G, Figure 45).

8. The procedure should not be used if a high flow (flood) event occurs prior to monitoring. In that situation, the water's energy and sediment will make it very difficult to determine if the effects are a result of the current grazing season or past grazing seasons.

Streambank Stability

General Description

Streambank stability is observed within the 50 cm (19.6 inches) quadrat on the streambank and is expressed as a percentage of the streambank in one of six stability classes (see Streambank Stability Classification descriptions below and Appendix K).

Procedure

At each plot location, evaluate the condition of the streambank within the plot and record the stability class. If the plot along the greenline does not include the streambank, project the length of the plot, 50 cm (19.6 in.) to the streambank and record the stability class (see Appendix K, Streambank Stability Key). The following are steps that are useful in determining the stability class.

1. **What kind of bank?** Is the bank depositional (inside of channel bends and bars are usually present) or erosional (outside of bends/straight channel)? [See Appendix K]

2. **Where is the bank?** The length of frame (50 cm) between scour line and the top of the first terrace. Typical scour line indicators are the elevation of the ceiling of undercut banks, at or slightly above the summer low flow elevation, or on depositional banks, the scour line is the lower limit of sod-forming or perennial vegetation (see Appendix K).

3. **Is it Covered?** At least 50% aerial cover of perennial vegetation, cobbles six inches or larger, anchored large woody debris (LWD) with a diameter of four inches or greater, or a combination of the vegetation, rock, and/or LWD is at least 50 percent.

4. **Is it stable? None of the following exist:** Either a <u>fracture</u> (crack is visibly obvious on the bank), <u>slump</u> (portion of bank has obviously slipped down, been pushed down by trampling or shearing, etc.), or <u>slough</u> (soil is breaking or crumbling and falling away and is entering the active stream channel) **or** the bank is steep (within 10 degrees of vertical), bare, and eroding.

<u>Streambank Stability Classification</u>

Appendix K provides definitions, key, illustrations, and photographs. After assessing the plot, record the data on the Riparian Monitoring Data Sheet shown in Appendix F or in the handheld computer by one of the following six-streambank stability classes:

CS - Covered and stable (non-erosional). Streambanks are covered with perennial vegetation, and/or cobble (6 inches or bigger), boulders, bedrock, or anchored wood (4 inches in diameter or larger) to protect them from the erosive effects of water. Streambanks do not have indications of erosion, breakdown, shearing, or trampling that exposes plant roots. Banks associated with gravel bars having perennial deep-rooted vegetation along the edge of the floodplain line are in this category (see Appendix K, Illustrations and Figures)

CU - Covered and unstable (vulnerable). These streambanks are covered with perennial vegetation and occur where undercutting by water may cause breakdown, slumping, nicks, bank shearing, and/or fracturing along the bank (see Appendix K, Illustrations and Figures)

US - Uncovered and stable (vulnerable). Streambanks having consolidated soils high in clay, particularly in the lower part of the streambank, may be uncovered and stable. These banks are vulnerable to high flows, particularly winter flows with floating ice. Uncovered and stable banks may also be compacted streambanks trampled by concentrations of ungulates, human trails, vehicle crossings, or other activities that cause compaction. Such disturbance flattens the bank so that slumping and breakdown does not occur even though vegetative cover is significantly reduced or eliminated (see Appendix K, Illustrations and Figures).

UU - Uncovered and unstable (erosional & depositional). These are bare, eroding streambanks and include all mostly uncovered banks that are at a steep angle to the water surface. When the bank is not present due to excessive bar deposition or to streamside trampling, the bank will be classified "uncovered/unstable." (See Appendix K, Illustrations and Figures)

FB - False bank (stable). Streambanks have slumped in the past but have been stabilized by vegetation. These banks are usually at a lower level than the terrace and are covered/stable (CS). (see Appendix K, Illustrations and Figures).

UN - Unclassified. Side-channels, tributaries, springs, road crossings, etc., cause a break in a streambank. Livestock or wildlife trails are not included in this category, but are included as uncovered/stable (see "US" above).

Streambank Cover

Streambanks are considered covered if they show any of the following features:

1. Perennial herbaceous and/or woody vegetation provide more than 50 percent ground cover of the vertical height of the streambank (Bauer and Burton, 1993).
2. Roots of vegetation cover more than 50 percent of the bank. (Deep rooted plants such as willows and sedges provide such cover.)
3. Cobble size rocks (at least 6 inches in diameter), boulders, or bedrock cover more than 50 percent of the streambank surfaces.
4. Logs, at least four inches in diameter, cover more than 50 percent of the bank surfaces.
5. At least 50 percent of the bank surfaces are protected by a combination of the above.

Streambank Stability

Streambanks are considered stable if they do not show indications of any of the following features:

1. Breakdown: Obvious blocks of streambanks have broken away and lying adjacent to the bank breakage.
2. Slumping Bank: Bank that has obviously slipped down. Cracks may or may not be obvious, but the slump feature is obvious.
3. Bank Shearing: Occurs when animals walk along the streambank or cross the stream and shear or break off portions of the streambank. Bank shearing is recognized by a shear plane with obvious hoof marks on the streambank. Include the total length of bank disturbance associated with the shearing.
4. Fracture: A crack is visibly obvious on the bank indicating that the block of bank is about to slump or move into the stream.
5. Vertical and Eroding: The bank is mostly uncovered, and the bank angle is steeper than 80 degrees (178 % slope) from the horizontal.
6. Bare Depositional Bar: A depositional bar without adequate ground cover (50%).

Residual Vegetation Measurement (Stubble Height)

General Description

The objective of residual vegetation (stubble height) measurement is to determine the height of key vegetation species remaining following a period of grazing. The measurement may be used in two ways: first, to determine when livestock should be moved from the riparian area, and second, at the end of the grazing season, to determine whether changes to livestock grazing management are needed the following year.

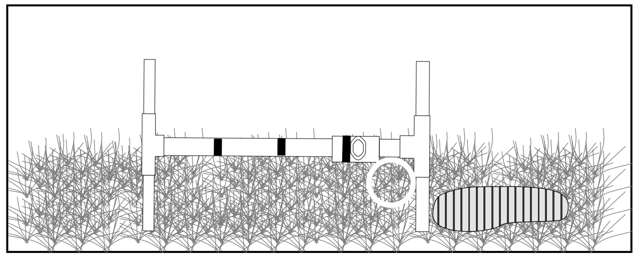

Figure 4 — residual vegetation height is measured within a 3-inch diameter circle at the back right-hand corner of the greenline quadrat nearest the frame handle.

Procedure

Most riparian key species grow tightly together, forming dense mats with little distinct separation of individual plants; the sampling method uses a 3-inch diameter circle of vegetation rather than separating the mats of distinct individual plants. When this occurs, select the 3-inch circle of vegetation nearest the handle of the monitoring frame (see Figure 4). Using a ruler that shows one-inch increments, measure several places within the circle to determine an "average" leaf length (rounded to the nearest ½ inch).

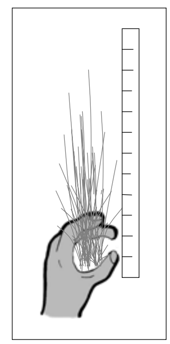

Figure 5 — form hand into an approximate 3-inch circle, grasp the vegetation and determine the average leaf height to the nearest ½ inch. Do not include seed culms.

Grazed and ungrazed plants are measured from the ground surface to the top of the remaining leaves. Account for very short leaves as well as the tall leaves. Do not measure seed culms. Determining the "average" residual vegetation height will take some practice. Be sure to include all of the key hydric graminoid species' leaves within the sample. The easiest method of doing this is to grasp the sample in the sampler's hand, stand the leaves upright, and then measure the average height (see Figure 5).

- When the key graminoid species do not occur in a mat near the handle of the quadrat, but as individual plant or several individual plants, the 3-inch plot is placed over the key species plants nearest the handle (see Figure 6). Measure the leaves of all the key graminoid species rooted within the 3-inch diameter

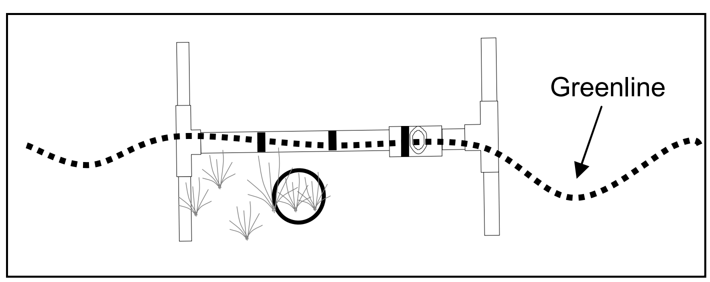

Figure 6 — when key species plants are not in the corner by the frame handle, select the key species plant(s) nearest the handle. Identify the 3-inch circle and measure the leaf height of all key species plants rooted within the circle.

plot.

• Prior to recording stubble height, one or more a key specie(s) must be selected. For this protocol, at least *one* of the key species selected must be a relatively abundant herbaceous forage plant, commonly used by livestock, and if measured be able to help address some aspect of streamside conditions and grazing management. In other words, the observer must establish what the species is "key" to and why it is important to measure. It is acceptable to use more than one key species if desired to help address other important issues. For example, species such as Kentucky bluegrass or red top can be (and should in some instances) measured if it helps answer grazing questions. Record the measurements by species.

When a key graminoid species does not occur within the quadrat, leave the cell blank and proceed to the next plot location.

Once the samples are collected, the usually the **median,** **not the mean (average) height,** is calculated for the riparian key specie(s). Median riparian stubble height is calculated by listing, in ascending order of heights, from the measurement with the tallest height to the measurement of the shortest height. The median is the single mid-point for an odd number of samples and the average of the two "co" midpoints for an even number of samples (USDI, BLM, 1999). For example, if the middle two numbers for an even number of samples are 5 and 6 inches, the median is 5.5 inches. The Data Analysis Module will calculate both mean and median stubble height.

Woody Species Regeneration
(Modified from Winward 2000)

General Description

Woody species regeneration is modified from Winward (2000). The original procedure is a six-foot wide by 110-meter belt transect with the center of the six-foot belt being over the greenline. Woody plants are counted by specie and age classed. This modification to facilitate collecting multiple indicators in a more efficient manner uses a 0.42 meter by 2 meter plot, 1 meter either side of the greenline, providing a sample of woody species along the transect. The woody plants are identified by specie and classified by age class.

Procedure

Identify the plant by specie; count the number of plants rooted in the plot, and age class (described below) of each woody plant within the plot.

1. The woody species regeneration plot is 2 meters by 0.42 meter, one meter on each side of the greenline (see Figure 7).

2. Place the end of the monitoring frame on and perpendicular to the greenline, and count the

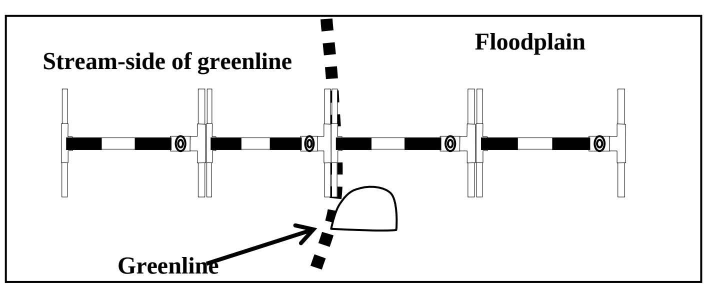

Figure 7 — woody species regeneration plot is 0.42 meters by 2.0 meters. The plot is defined by placing the monitoring frame perpendicular to the greenline. The frame is placed end-to-end on each side of the greenline.

number of woody plants by species **rooted** within the monitoring frame. If one stem at ground level is within the plot and several other stems are immediately outside the plot, determine if the stem within the plot is actually connected to those outside the plot. If it is, record the age of the entire plant to which the stem is connected.If it is not connected, consider the stem as an individual plant and record the age class appropriately. Record by species and age class. (Do not count woody species canopy cover as woody species.)

6. Move the monitoring frame away from the greenline, and place it at the end of the first monitoring frame, and repeat the procedure (see Figure 7).

7. Tables 2 and 3 provide descriptions of woody species age classes.

8. It is difficult to age class rhizomatous species such as wolf willow (*Salix wolfii*), planeleaf willow (*S. planifolia*), coyote willow (*S. exigua*), wild rose (*Rosa* spp.), and golden current (*Ribes aureum*), and they are not recommended for inclusion in the woody species regeneration. When these species need to be monitored, use the greenline or a line transect.

Table 2 – Woody Species Age Classes for Multiple Stem Species
Includes clumped willow (*Salix* spp.) species and shrubby forms of mountain alder (*Alnus incana*), and water birch (*Betula occidentalis*)

Number of stems at the ground surface	Age class
1 stem	Sprout/Seeding
2 to 10 stems	Young
>10 stems	Mature
0 stems alive	Dead

Modified (Winward 2000)

Table 3 – Woody Species Age Class for Single Stemmed Species
Single stemmed species such as birch (*Betula* spp.), alder (*Alnus* spp.), and cottonwood or aspen (*Populus* spp.)

Age Class	Cottonwood	Other Broadleaf Species
Seedling	Stem is < 4.5 ft. tall or < 1 in. diameter breast height (dbh)	Stem is < 3 ft. tall and the stem is less than 1 in. diameter at the base
Young	Stem is ≥ 4.5 ft. tall and 1 to < 5 in. dbh or stem is < 4.5 ft. tall and is 1 to < 5 in. dbh	Stem is ≥ 3 ft. tall and < 3 in. dbh or < 3 ft. tall and the stem is 1 to 3 in. dbh
Mature	≥ 5 in. dbh	Stem is ≥ 6 ft. tall and ≥ 3 in. dbh or < 6 ft. tall and ≥ 3 in. dbh or stems < 3 ft. tall with multiple branching (hedged) near the top of the stem
Dead	Entire canopy is dead	Entire canopy is dead

Adapted from (Thompson et al, 1998)

Greenline-to-Greenline Width (GGW)

General Description

Many stream channels are over-widened as a result of vegetative changes and physical disturbance to streambanks over time. Improper livestock grazing can alter stream habitats by channel widening and/or incision (Clary et. al. 1996, Clary 1999, Clary and Kinney 2002, Kaufman and Krueger 1984). Under improper grazing, protective vegetation is weakened or removed, and trampling may induce a sloping streambank profile (Clary and Kinney 2002). Subsequent erosion of weakened streambanks during floods results in a wider, shallower stream channel. These changes to stream habitats can be detrimental to biota (Bohn 1986). Clary's (1999) observations at research sites indicated that the stream width of previously over-grazed streams decreases with improved grazing management of riparian zones. The average amount of narrowing was inversely associated with the level of grazing intensity. Between 1990 and 1994, width changes as a proportion of the original measurement were: No grazing – 41% reduction, light grazing – 34% reduction, and medium grazing – 18% reduction. Stream depth, on the other hand, was variable through time and appeared to change primarily in response to climatic events. After a flood event in 1996, channel depth at the ungrazed site increased to 2.33 times the original depth. This vertical scour likely resulted from the longer-term effect of channel narrowing.

Commonly the width of stream channels is determined by measuring channel width at the bankfull level. Detailed measurements of width and depth are accomplished by surveying channel cross-section profiles. This method is not useful at a large number of positions along the stream because it is time-consuming and expensive. Too few cross-section measurements do not adequately estimate mean channel geometry, due to site variability.

As summarized by Bauer and Ralph (2001), the major concern with use of width measurements at bankfull level is the reliability of the method. Bankfull width is determined by using field characteristics such as sediment surfaces and profile breaks to identify the elevation of the active floodplain surface. These definitions are vague and the actual selection of bankfull level is, at best, subjective.

Other field methods have measured the "wetted width" of the stream. Although this level in the channel is easily identifiable, unfortunately, wetted width varies dramatically by stream flow. Because it is normally measured during low or intermediate streamflows, it provides little information about the overall channel characteristics of the measured stream.

Greenline-to-greenline width (GGW) is the non-vegetated distance between the greenlines on each side of the stream. As stated by Winward (2000):

> "Most often the greenline is located at or near the bankful stage. As flows recede and the vegetation continues to develop summer growth, it may be located part way out on a gravel or sandbar. At times when banks are freshly eroding or, especially when a stream has become entrenched, the greenline may be located several feet above bank-full stage."

Though related to the bankfull stage, the greenline is easier to identify. In a recent meeting of scientists working to achieve greater consistency in riparian monitoring, it was determined that the greenline can be even more objectively determined if a set of rules or criteria could be identified. A sub-group was identified and a product developed early in 2005. These criteria are contained within this monitoring protocol (page 6), and they build on the original definition of Winward (2000).

To achieve an adequate sample for estimating the mean width (GGW), take measurements at each plot location. The results are a mean width of the non-vegetated stream channel. As streambanks recover, the stream channel typically narrows and the average non-vegetated GGW is reduced.

This indicator helps document stream channel recovery over time. Since the recovery process may be relatively slow, it is recommended that the procedure be repeated every three to five years. The procedure is relatively easy and does not consume a lot of time.

Procedure

1. At each plot location (see Appendix C, Figure 1), measure the distance between the greenlines on each side of the stream and perpendicular to the water flow direction. A laser range finder is the most expedient way of measuring the distance. It reduces the time required to do the measurements by about two-thirds. However, these instruments capable of a measuring accuracy of ±0.3 meter are about $700.00, while those accurate to ±0.03 meter are $2,400.00. Other less expensive options include measuring rods and tape measures.

2. Measure from the greenline associated with the center bar on the quadrat frame (near the toe of the boot (see Appendix C, Figures 2), to the greenline on the opposite side of the stream. The measurement is usually taken from only one side of the stream. If there are an inadequate number of samples, measurements may be taken from the opposite side of the steam. Measure to the nearest 0.25 feet or 0.1 meter.

3. The measured distance is from the edge of the rooted base of the plants on the greenline, not the overhanging or overstory vegetation (see Appendix K, Figures 1 and 2).

4. When a vegetated island (at least 25% foliar cover) is encountered along the line, determine the total distance between the greenlines and deduct the length of the vegetated island to determine the non-vegetated GGW (see Appendix K, Figures 3, 4, 5, and 6).

5. Non-vegetated islands are considered part of the non-vegetated GGW (see Appendix K, Figure 5).

Woody Species Use *(Modified Landscape Appearance Method)*

General Description

This method is modified from the Qualitative Assessments – Landscape Appearance Method (also called the Key Forage Plant Method) described in *Utilization Studies and Residual*

Measurements, Interagency Technical Reference, 1996. Winward (2000) recommends a similar method based on estimated utilization ranges.

The technique is an ocular estimate of woody species (e.g., willow, alder, birch, dogwood, aspen, and cottonwood) use based on the general appearance of the woody species **rooted** within a plot along the greenline. Estimates are based on a range or class of use of the available current year's growth on the plants. Examiners must be trained to recognize the various use classes according to written class descriptions described below.

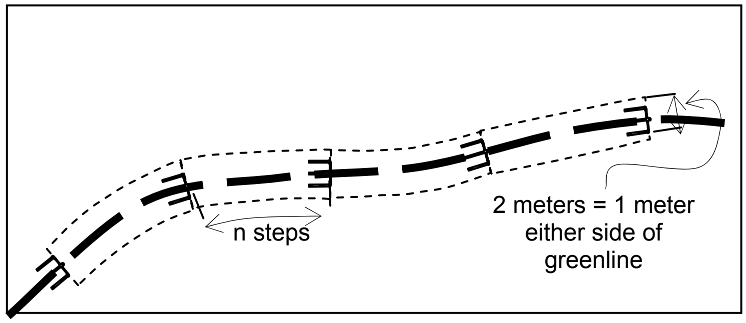

Figure 8 — the plot size for selecting woody species is two meters wide. The length of the plot is number of steps (n steps) between plots. For example, if the plot interval is **two** steps, the area from which shrubs may be selected is **two** steps long.

Procedure

The plot size (see Figure 8) for obtaining woody species use is 2 meters wide (1 meter either side of the greenline), and the length is determined by the interval between plots. For example, if the distance between plots is two steps, observe all of the shrubs rooted within 1 meter either side of the greenline for a distance of two steps forward and record the mid-point value (see Table 5) of each key woody species use class. Or, if the plot interval is four steps (two paces), observe all of the shrub plants rooted within 1 meter either side of the greenline and within four steps forward and record the mid-point value of each key woody species.

For cattle, only shrubs with at least 50 percent of the current year's leader growth below 5 feet (see Table 4) should be considered. When shrubs have over 50 percent of the active leader growth above 5 feet, the leaders are not generally available to cattle, and the plant usually has adequate leaf area for photosynthesis to maintain plant health. If no shrubs are encountered within the plot, leave the space on the field data sheet blank. When active grazing is commonly observed on shrubs over 5 feet tall, the criteria may be modified and documented on the data sheet.

Examiners observe the woody plants rooted within plot (see Appendix M) and classify the use based on the descriptors. The five utilization classes (see Table 5) describe the relative degree of use of the available current year's leader growth for riparian shrubs and trees. Available current year's leader growth (see Table 4) is that portion of shrubs or trees that are within reach of the grazing animal.

Use the appropriate "Height of Available Leader Growth" for the kind of animals that are of concern in the area. It is difficult, if not impossible, to discern between shrub use by domestic livestock and wildlife during periods of common use. Therefore, attempts to determine the kind of animal that use the browse should not be made.

Table 4– Available Current Year's Growth:
Height of Grazing (USDI, BLM, 1992)

Kind of Animal	Height of Available Leader Growth (feet)
Cattle	5
Sheep, antelope, big horn sheep	3.5
Horses, elk, and moose	7
Deer	4.5

Table 5 – Woody Species Use Classes and Descriptions

Class	Percent Utilization Range	Description
None to Slight	0 - 10 (mid-point = 5)	Browse plants appear to have little or no use. Less than 10% of the available current year's leader growth is disturbed.
Light	11– 40 (mid-point = 25)	There is obvious evidence of leader use. The available leaders appear cropped or browsed in patches and 60 - 89% of the available leader growth of browse plants remains intact.
Moderate	41 – 60 (mid-point = 50)	Browse plants appear rather uniformly used and 40 - 60% of available annual leader growth of the plants remains intact.
Heavy to Severe	61 – 90 (mid-point = 75)	The use of the browse gives the appearance of complete search by grazing animals. The preferred browse plants are hedged and some clumps may be slightly broken. Only between 10 and 40% of the available leader growth remains intact.
Extreme	90 – 100 (mid-point = 95)	There are indications of repeated grazing. There is no evidence of terminal buds. Some patches of second and third years' growth may be grazed. Hedging is readily apparent and browse plants are frequently broken. Repeated use at this level will produce a definitely hedged or armored growth form. Ten to 40% of the more accessible second and third years' growth of browse plants have been utilized. All browse plants have major portions broken.

DATA INTERPRETATION

Data must be interpreted within the precision and accuracy for each monitoring indicator. Precision denotes the amount of agreement between repeated measurements by the same observer and/or different observes. It reflects both the expertise of the observers and the rigor of the procedure. Accuracy is the amount of agreement between the estimate and the true mean value, usually reflecting the number of samples collected and the variability of the site. Sample size estimates are used to evaluate each monitoring indicator to estimate accuracy. See Appendix N for statistical analysis of testing of monitoring results, ranges of precision, and sample sizes needed to accurately predict means. Electronic data entry may be used to assess sample size levels using an EXCEL workbook, the Data Entry Module, which is designed to be used with PDA's (including conversion to Micro EXCEL). See appendix E for details.

A number of metrics were created to evaluate and summarize the data. These metrics are calculated using an EXCEL workbook, the Data Analysis Module. A description of the module is contained in appendix E. The following list of variables is obtained by using the module. Refer to the Module for descriptions of each metric and how it is derived.

Median and Mean Stubble Height
Percent Streambank Alteration
Percent Woody Use
Percent Bank Stability
Percent Bank Cover
Percent Saplings
Percent Mature
Percent Dead Woody
Percent Hydric Vegetation
Greenline Stability Rating

Table 6– Vegetation Erosion Resistance Index (referred to as the Greenline Stability Rating in Winward 2000)

Summary Value	Descriptor Class Rating
0-2	Very Poor (very low)
3-4	Poor (low)
5-6	Moderate
7-8	Good (high)
9-10	Excellent (very high)

Ecological Status

Table 7– Greenline Ecological Status
(Winward 2000)

Summary Value	Descriptor Class Rating
0-15	Very Early
16-40	Early
41-60	Mid
61-85	Late
85+	PNC

Site Wetland Rating

Table 8– Site Wetland Rating

Summary Value	Descriptor Class Rating
0-15	Very Poor

16-40	Poor
41-60	Fair
61-85	Good
85+	Very Good

Greenline-Greenline Width
Percent Hydric Herbaceous
Dominant key species for Stubble height/Height of dominant key species for stubble height

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